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THE ULTRAVIOLET SIGNATURE OF MASSIVE STARS IN STARBURST GALAXIES

CARMELLE ROBERT, CLAUS LEITHERER[1], AND TIMOTHY M. HECKMAN[2]
Space Telescope Science Institute, 3700 San Martin Dr., Baltimore, MD 21218
[1] Affiliated with the Astrophysics Division of ESA
[2] Johns Hopkins University, Dept. of Physics and Astronomy

ABSTRACT We present a progress report of a study of the massive star population in starburst galaxies using the UV spectral region.

INTRODUCTION

Studies in different spectral regimes of starburst galaxies clearly indicate the presence of hot, massive stars (see *STScI Sym. 5: Massive Stars in Starbursts*, 1991). However, only the UV spectral region can be used to directly identify the spectroscopic signature of these stars. The typical contributor to the integrated continuum at ~ 1400 Å of a starburst is from the hot B stars. More massive stars (O stars and their descendants, the Wolf-Rayet [W-R] stars) are responsible for the majority to the UV lines which are broad (compared to the interstellar [IS] lines) photospheric absorption lines and wind emission or P Cygni profiles.

POPULATION SYNTHESIS MODELS

The line profiles of SiIV λ1397 and CIV λ1549 are synthesized with the latest generation of stellar evolution models (Maeder 1990, *A&AS* 84, 139), stellar atmospheres (Kurucz 1992, *IAU 149*, p. 225; Schmutz *et al.* 1992, *PASP* in press), and a line profile library based on IUE high dispersion spectra of massive stars (except for the B stars for which we use low dispersion spectra at the moment). Stellar populations for continuous and instantaneous bursts are calculated given a certain slope (α) and cut-off masses (M_l and M_u) for the initial mass function (IMF). An interpolation is done for a mass interval of 1 $M_\odot$ and a time resolution of 10^4 yr.

RESULTS

Figure 1 shows the relative number of massive stars in an instantaneous burst. As one can see, the most massive stars, O and W-R stars, disappear after $\simeq 10^7$ yr. The number of BV-IV stars slightly decreases with time while the number of BI-III stars is increasing.

In figure 2, we present the SiIV and CIV profiles synthesized for the stellar population described in figure 1. At $t \simeq 10^{6.5}$ yr, the SiIV doublet has a P Cygni type profile (over which the IS component is superposed). This wind profile shape is due to an increased number of O supergiants and W-R stars. At $t \geq 10^{6.8}$ yr, the SiIV doublet is broad but not blue shifted anymore. B stars, which have become the dominant contributors, are responsible for this profile shape (along with

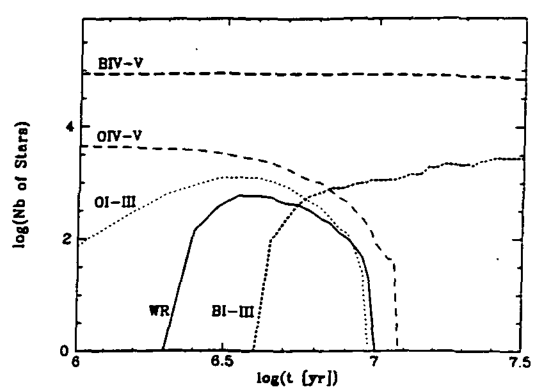

FIGURE 1. Number of stars as a function of time for an instantaneous burst of total mass 10^6 $M_\odot$ ($Z = Z_\odot$, $\alpha = 2.35$, $M_l = 1$ $M_\odot$, and $M_u = 120$ $M_\odot$).

the IS medium). Massive main sequence stars have a CIV doublet which already shows a P Cygni type profile. This profile increases in strength and become narrower as the winds from O supergiants becomes more important ($t \simeq 10^{6.5}$ yr). Later on, B stars and the IS medium are responsible for a weak CIV feature.

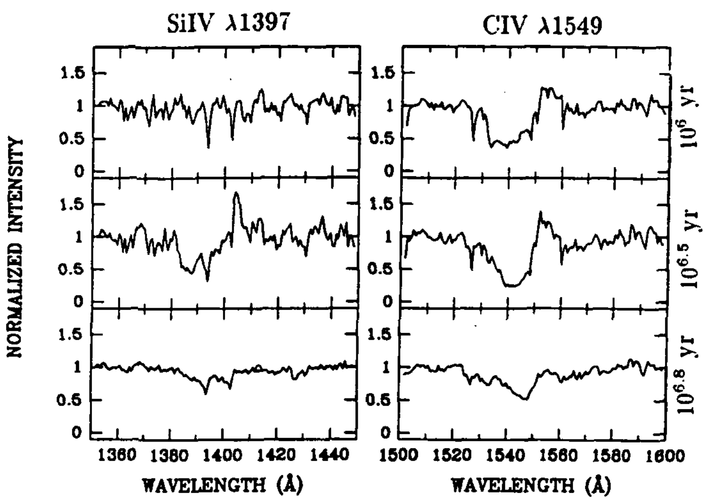

FIGURE 2. Synthetic SiIV and CIV line profiles of a burst at three evolutionary phases. (Model parameters are as in fig. 1.)

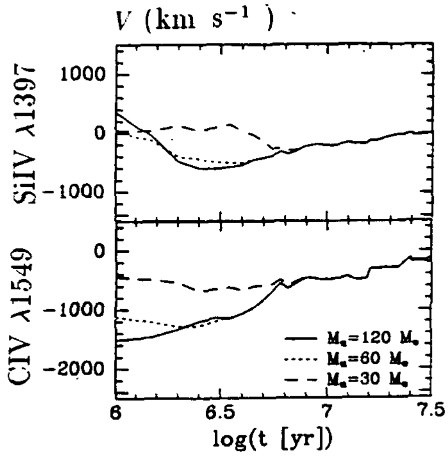

FIGURE 3. Synthetic SiIV and CIV velocity shift as a function of time for three upper cut-off mass limits. (Model parameters are as in fig. 1.)

The velocity shifts described in the synthetic profile of figure 2 are quantitatively presented in figure 3 (solid line for $M_u = 120\ M_\odot$). One can clearly see the blue shift of SiIV after $\simeq 10^{6.5}$ yr due to stellar winds from massive stars. CIV is shifted back to the laboratory wavelength as time passes, *i.e.* as massive stars are dying.

In figure 3, the velocity shifts are presented for 3 models using different values of M_u. For $M_u = 60\ M_\odot$, the main sequence star contribution to CIV is reduced at early phases. For $M_u = 30\ M_\odot$, most massive stars are absent and the profiles are virtually unshifted. No important dependences of the SiIV and CIV velocity shifts with α (*i.e.* from 1.5 to 3) are observed.

OBSERVATIONS OF STARBURST GALAXIES

We have selected a sample of 49 starburst galaxies from IUE archives based on their high signal-to-noise ratio. For this sample, we calculate an average velocity shift of -490 and -745 km s^{-1} for SiIV and CIV, respectively. No significant shifts (larger than ± 200 km s^{-1}) are seen for simple lines formed in the IS medium. Based on our models, the large blue shifts observed for SiIV and CIV clearly indicate the presence of massive stars, $> 30\ M_\odot$, in most of our galaxies. In the case of NGC3256, for which Joseph (1991, *Massive Stars in Starbursts*, p. 259) estimated M_u = 25-30 $M_\odot$ based on IR data, we obtain large blue velocity shifts for SiIV and CIV (-611 and -1125 km s^{-1}). This result argues in favor of a large value for M_u.

The full potential of our method will be exploited on the basis of Hubble Space Telescope data of several galaxies available in a near future.

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